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# **Using Cost Estimating Relationships to Develop A Price Index for Tactical Aircraft**

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- Provide a factual and analytic basis for responding to the requirements of the Weapon Systems Acquisition Reform Act (WSARA)
- Improve inflation-related practices in the acquisition community
- Better understand how to measure changes in real defense spending

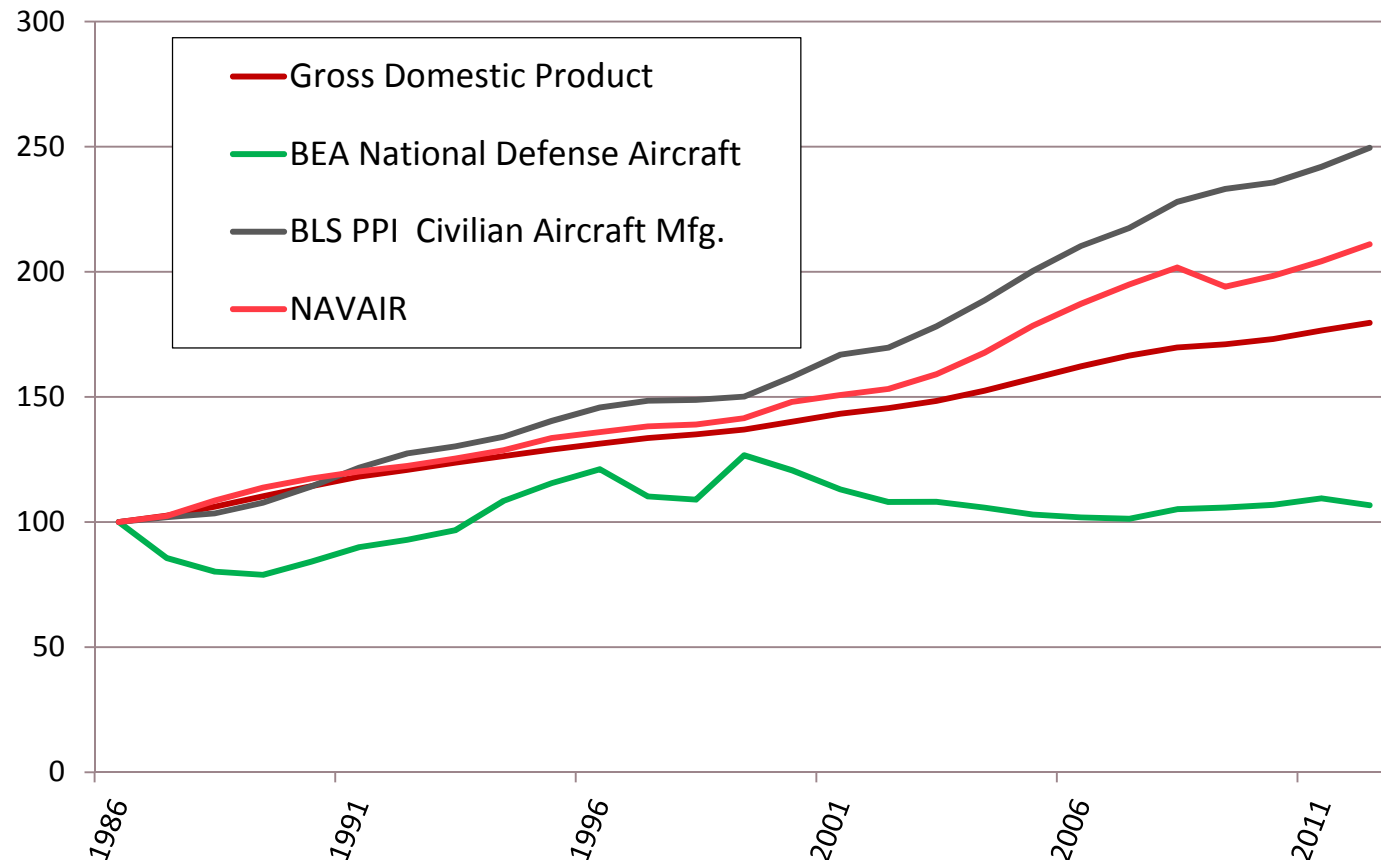
- Identify the content and uses of inflation adjustments
- Compare the official inflation rate with leading alternatives
- Use analysis based on cost-estimating relationships to develop quality-corrected price indexes for tactical aircraft

# Content and Uses of Inflation Adjustments in Acquisition

- System prices may change because
  - The overall price level changed – general inflation
  - Prices of system labor and materials changed differently than overall prices
  - Learning occurred or production rates changed
  - Supply or demand conditions in the industry changed
  - Quality (system characteristics) changed
- Inflation adjustments may reflect some or all of these changes
- What is captured depends on the purpose

	Elements of Price Change Captured			
	Growth in price for a particular system	Growth in price for a particular system relative to general inflation	Growth in spending for a class of items relative to general inflation	Growth in spending for a class of items, adjusting for DOD's quality-constant price changes
<b>Reasons for Price Changes</b>				
General inflation				
Relative inflation of inputs				
Production-related factors				
Industry-related factors				
Quality changes				
<b>Use of Adjustment/User</b>	Prepare budget/Program office	Measure real cost growth/Program office, Congress, OSD	Measure real burden to the economy/OMB	Measure real quantity of defense-related goods purchased/DoD leadership

# Existing Price Indexes Relevant to Aircraft



- Bureau of Economic Analysis (BEA) and Bureau of Labor Statistics (BLS) series, based on aircraft prices, try to hold quality constant
- Naval Air Systems Command (NAVAIR) series based on input prices
- Questions
  - Why is BEA index so flat?
  - Why is BLS index so much higher?
  - Are there better alternatives?

- Both indexes are designed to reflect price changes for constant-quality aircraft
  - Adjusting for the price of quality improvements is difficult
  - Overstating price of quality improvements will bias index downward
- BEA and BLS procedures are equivalent for existing aircraft – measure the price of improvements based on contractor reports
- BEA procedure for estimating the price of improvements in new aircraft
  - Adjust price of new aircraft for expected learning and general inflation between final purchase of old aircraft and initial purchase of new, then subtract price of old aircraft from price of new one
  - Difference is the estimated price of quality improvements
  - Will overstate price of quality improvements if learning is less than expected
- BLS procedure for estimating the price of improvements in new aircraft
  - Subtract price of old aircraft from price of new one, with no learning correction
  - Difference is the estimated cost of quality improvements
  - Looks likely to yield greater overestimate of cost of quality improvements
  - However, initial prices of new commercial aircraft may be well below cost, so failure to account for learning may be unimportant

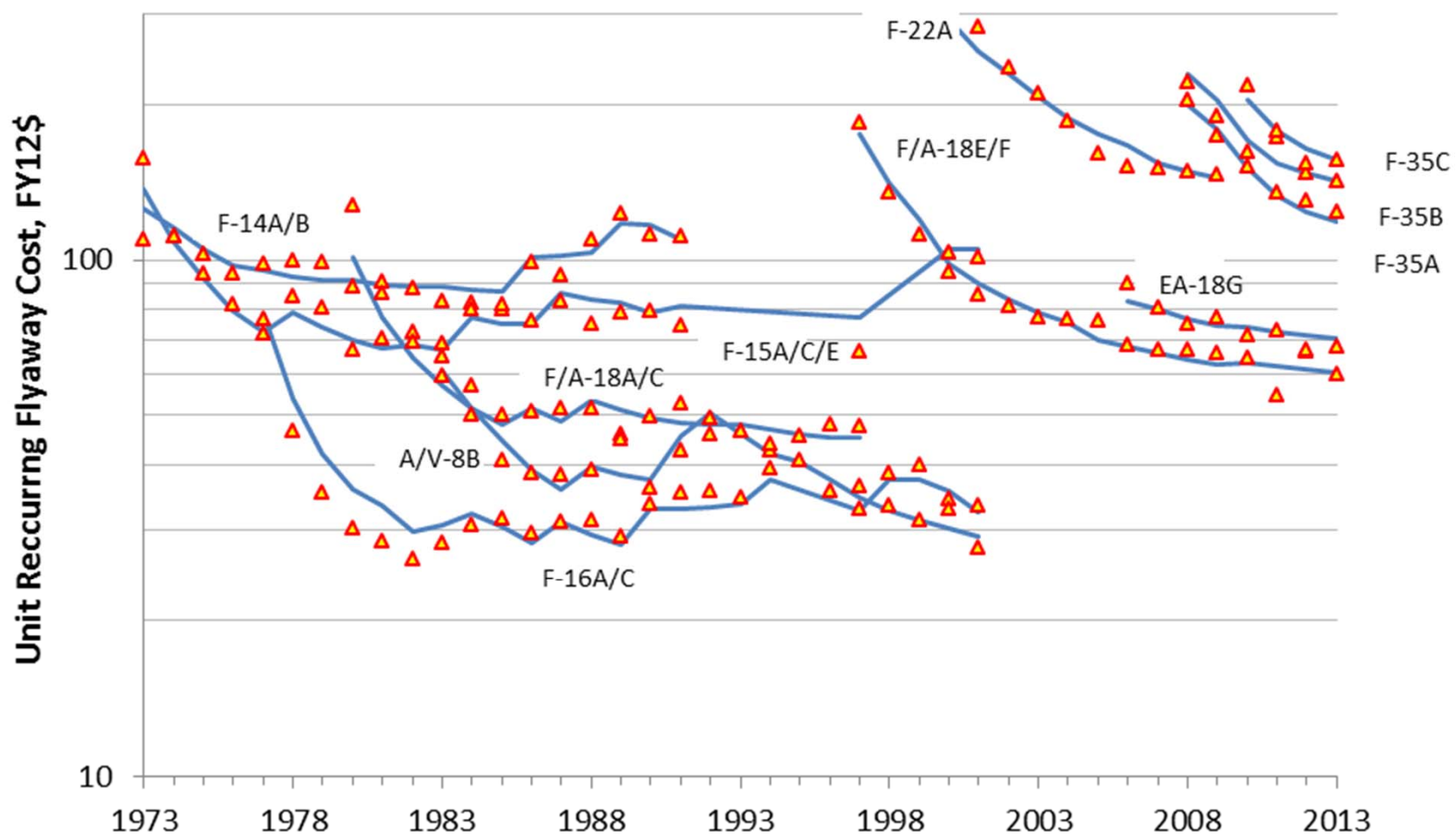
The BEA index may be too low, but we do not know enough about the values used in their calculations to know—so let's make our own!

- To measure changes in the “real” quantity of defense-related goods purchased, we must deflate expenditures using a price index that measures changes in price of the *same product*—i.e., holding quality constant
  - “Quality” refers to characteristics that improve a system’s performance
  - For example, improvements in engines and avionics
- Current (BEA and BLS) cost indexes hold quality constant by estimating the cost of quality improvements
- Hedonic approach holds quality constant by using cost estimating relationships (CERs) relating cost to quality characteristics. Uses time dummies to get price index.
- We have used hedonic techniques to build price indexes or estimate rate of price increase for tactical aircraft, ground vehicles, missiles, and submarines



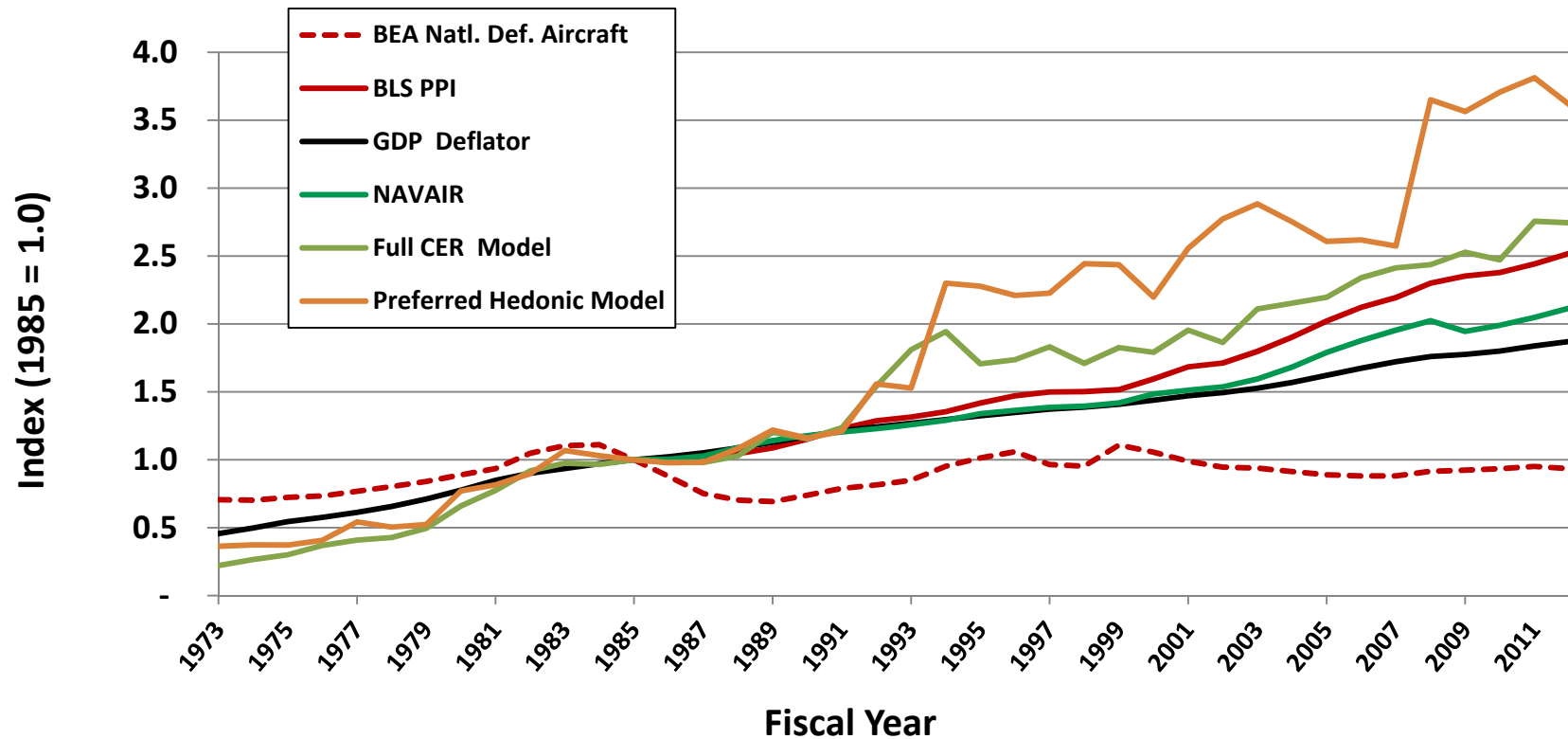
- Forty-one years (1973–2013)
- Eleven aircraft models
  - F-14
  - F-15
  - F-16
  - F/A-18
  - A/V-8B
  - F/A-18E
  - F-22
  - EA-18G
  - F-35A
  - F-35B
  - F-35C
- 150 data points – lot purchases

- Dependent variable: unit lot recurring flyaway cost
- Independent variables
  - Production factors: cumulative quantity and lot size – learning slope: 85%
  - Aircraft empty weight
  - Maximum speed
  - Structural material composition
  - 5<sup>th</sup> generation (captures stealth, internal weapons carriage, information fusion, net-centric capability) – 11% increase in cost
  - Short Take-off and Vertical Landing (STOVL) capability – 10% increase in cost
  - Time dummy variables – parameters determine price index
- Results:  $R^2 = 0.97$ ; correct signs, significant at .05



- Based on analysis including quantity effects (Full-CER model)
  - An estimate of trends in first-unit prices
  - We really want trends in actual prices
- We removed quantity effects in two ways
  - Keeping the quality-related effects estimated in Full-CER model (preferred approach, because based on more appropriate quality parameters)
  - Re-estimating time trends in a formulation that omitted quantity effects (alternative approach). Did not work as well.

# Comparisons of Price Indexes



Hedonic indexes rose more rapidly (>6%) than Gross Domestic Product (GDP) deflator (<4%) and all other alternatives

- We provided a summary of the various uses of inflation adjustments in Department of Defense (DoD) and a taxonomy for thinking about them
- Existing price indexes used for aircraft differ substantially
  - BEA index for defense aircraft shows no growth since 1980s
  - BLS Producer Price Index (PPI) for commercial aircraft is much higher
  - GDP deflator and NAVAIR index are in between
  - DoD officials believe the GDP deflator is too low relative to the prices of defense aircraft
- Hedonic cost estimating methods provide a way of developing price indexes for a wide range of system types
  - Using these methods shows aircraft procurement prices have risen more rapidly than the GDP deflator and the NAVAIR index
  - Use of the GDP deflator to calculate real growth in spending on tactical aircraft tends to overstate the real quantity of procurement taking place